

(19) **DANMARK**

(10) **DK/EP 2920456 T3**



(12)

Oversættelse af europæisk patentskrift

Patent- og
Varemærkestyrelsen

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- (51) Int.Cl.: **F 03 D 1/02 (2006.01)** **F 03 D 13/20 (2016.01)** **F 03 D 80/80 (2016.01)**
- (45) Oversættelsen bekendtgjort den: **2022-03-21**
- (80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2021-12-29**
- (86) Europæisk ansøgning nr.: **13798912.5**
- (86) Europæisk indleveringsdag: **2013-11-15**
- (87) Den europæiske ansøgnings publiceringsdag: **2015-09-23**
- (86) International ansøgning nr.: **CH2013000201**
- (87) Internationalt publikationsnr.: **WO2014075201**
- (30) Prioritet: **2012-11-16 CH 24252012**
- (84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**
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- (54) Benævnelse: **Vindturbineanlæg med tårnkonsol**
- (56) Fremdragne publikationer:
EP-A1- 0 102 657
EP-A1- 1 788 242
WO-A1-2010/098813
DE-A1- 4 432 800
JP-A- 2011 032 918
JP-A- 2011 106 274
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Wind turbine installation with tower console

Technical field

The present invention relates to a Wind turbine installation for power generation.

Prior art

For some time now, large, single-rotor wind turbine installations have been known placed at favorable locations to convert the energy of the wind into electrical energy and feed this into the power grid. These wind turbine installations are between 50 and 200 meters high and comprise rotor diameters of more than 90 meters. Due to the enormous height, the shadow cast by these wind turbines is also particularly large. The turbines themselves can hardly be overlooked in the landscape and also comprise a high degree of noise emissions due to the considerable rotor diameters. For this reason, particularly large turbines are preferably built in remote locations or even offshore, i.e. in the sea.

- 10 Although the social acceptance for renewable energies and "clean" energy sources is high, in the specific case of wind power plants, the construction of a new plant is usually opposed by local residents and landscape conservationists. In addition to the disadvantages in terms of acceptance by the population, the large wind turbines can only be built in limited locations, as they comprise a considerable moment of inertia due to their large rotor diameter, and thus cannot be operated
- 15 efficiently at locations with changing wind conditions and heights. In order to make better use of changing wind conditions, it is known to equip wind turbine installations with a wind tracking system. This wind tracking can be done, for example, by means of a yaw control, which enables adaptive wind tracking of the nacelle so that it is optimally positioned to the wind at all times. A sensor system reports the wind direction to the control system, which then operates actuators as
- 20 required.

To make wind turbines more widely accepted by society, the overall height of the turbine can be reduced. With such turbines, there is no way around increasing the number of turbines to achieve a significant output.

- 25 DE4432800 A1 (Hochtief AG) describes a wind turbine with a tower shaft from which at least one turbine protrudes. The wind turbine is rotatable about a vertical axis relative to the tower shaft. The whole turbine is stabilized by a supporting body. However, when such a turbine is built, its open structure makes it susceptible to damage, acts of vandalism, or more generally, a safety hazard to people and animals who are in the vicinity of the turbine. Since wind turbines are often built near farms or in recreational areas, safety is a factor that should not be underestimated.
- 30 US2012/051939 A1 (Up to Wind Corporation) shows a tower-shaped wind turbine. The turbine comprises a plurality of comparatively small diameter turbines. The turbines are placed in pairs on a support which is horizontal to a foundation. The turbines themselves are equipped as

impellers in US2012/051939 A1. The whole turbine can be lowered. Also it is possible that wind tracking can be done by an asymmetric wind load between the paired wind turbines. It is not clear from US2012/051939 A1 how or if this wind tracking can be actively controlled beyond the asymmetric wind load. Furthermore, the wind turbine extends very far into the height. Analogous to the above-mentioned DE4432800 A1, the base and the foot of this turbine are also susceptible to acts of vandalism, respectively a safety risk for humans and animals. Considering additionally the lowerability of the wind turbine, a large portion has to be fenced and sealed off for its placement.

It is therefore a task of the present invention to provide a wind turbine installation for power generation, which has a reduced installation height and does not have to accept any loss of power resulting from the size relation. In particular, it is a task of the present invention to provide a wind turbine installation which overcomes at least one disadvantage of the known, in particular a wind turbine installation is to be provided which has an increased safety.

Invention

This task was solved by a wind turbine installation according to the characterizing part of the independent claims.

One aspect of the present invention relates to a wind turbine installation for power generation. The wind turbine installation comprises a turbine support having at least two wind turbines. The turbine further comprises a tower console, which comprises at least one bearing point. This bearing point enables rotational movement of the turbine support about the vertical axis of the turbine support and relative to a foundation. Further, the wind turbine installation according to the invention comprises at least one tower pillar by which the turbine support is connected to the tower console. The wind turbine installation comprises electronics, which comprise an electronic controller. In the wind turbine installation, the electronics are configured to rotate relative to the foundation and a power network line about the vertical axis of the turbine support.

In terms of the present invention, the wind turbine as an assembly may comprise a nacelle having a hub provided with one or more, preferably between two and eight, rotor blades. The nacelle may also comprise the generator required to generate power. In the sense of the present invention, a bearing point can be any machine element capable of guiding a relative movement between two parts. In a particular embodiment, the bearing point according to the present invention is a sliding bearing. In a further particular embodiment, the bearing point according to the invention is a ball

bearing. In principle, the choice of bearing is of secondary importance to those skilled in the art as long as it allows relative movement between the turbine support and the foundation.

For the purposes of the present invention, the foundation is to be understood as a component which enables the turbine to be directly connected to a floor. In accordance with the present invention, the foundation may be a concrete or a profile or a scaffold. It is essential that the foundation is fixed in the ground at the intended location and cannot be moved.

According to the invention, in a particular example, the vertical axis of the turbine support may coincide with a central vertical axis of the entire wind turbine installation. This would be particularly the case in symmetrical embodiments.

In a particular embodiment, the turbine support is oriented substantially horizontally with respect to the foundation or ground. In terms of the present invention, the turbine support is oriented substantially horizontally if the turbine support deviates from a parallel plane to the ground or foundation by an angle less than 5 degrees. Basically, according to the invention, it should be understood that a horizontal line is always to be considered tangent with respect to the horizon and regardless of the topography, i.e., individual elevations or depressions, on which the turbine is built.

In a particular embodiment, the tower console is designed to be rotatable jointly with the turbine support. Thus, the tower console is rotatably mounted with its bearing point relative to the ground or foundation. In this embodiment, the tower console and the turbine support, as well as the wind turbines themselves, form a rotational unit relative to the ground or foundation.

In an alternative embodiment, the tower console is designed to be non-rotatable with respect to the foundation. In this embodiment, the turbine support is rotatably mounted with respect to the tower console via the bearing point of the tower console. As described above, this rotatable bearing would be analogous to a rotation about the vertical axis of the turbine console. Rotationally, in this embodiment, the tower console and the foundation form a unit against which the turbine support with the wind turbines is rotatably mounted.

In a particular embodiment, the wind turbine installation comprises at least one generator cable per wind turbine. In this embodiment, this is designed to be rotatable jointly with the turbine support. In a further particular embodiment, the generator cable runs from the wind turbines via the turbine support through the at least one tower pillar into an interior of the tower console. In yet another particular embodiment, the generator cable is completely enclosed by a component of the wind turbine installation at all times. Specifically, this means that turbine supports, and the at

least one tower pillar through which the respective generator cables would pass, are designed to enclose a cavity through which the respective generator cables can pass.

In a particular embodiment, the electronics of the wind turbine installation further comprise a yaw drive, a wind yaw tracker, a control line, and an electrical line. The yaw drive is a suitable means to ensure that the wind turbine installation can always produce the maximum possible amount of electrical energy. The yaw drive makes it possible to always ensure that the wind turbine rotors are always at the optimum angle to the wind direction and to correct this if the wind direction changes. The wind yaw tracker is used to determine the wind direction. From this measured wind direction, the correction angle for the yaw drive is determined by means of an algorithm in a particular embodiment.

In a particular embodiment, both the yaw drive and the wind yaw tracker are located in the rotatably mounted part of the wind turbine installation. The yaw drive may be a component of the tower console. The wind yaw tracker is ideally to be located where the wind force acts, respectively where the wind turbines operate. In a particular embodiment, the wind yaw tracker is placed on the turbine support in such a way that it is exposed to the same wind forces as the wind turbines themselves. To enable the wind yaw tracker to transmit measured signals to the electronics, in particular to the yaw drive, it is connected to the electronics by means of a control line. Further, an electrical line may be provided to transfer usable electrical power from the electronics to the yaw drive. In a particularly preferred embodiment, these components are housed in the tower console, or tower pillar, or turbine support, respectively, in such a way that they are substantially inaccessible from the outside. In the sense of the present invention, for example, a secured cable that can only be reached from the outside by bypassing a securing measure, such as a lockable box or a lockable hatch, can be regarded as a component that is substantially inaccessible from the outside.

In a particular embodiment, the wind turbine installation comprises at least one means for transmitting electrical signals between the rotatably arranged elements and a power network line in the ground. In a particular embodiment, the wind turbine installation comprises a slip ring for transmitting electrical signals between the electronics and the power network line.

In an alternative or complementary embodiment, the power network line is substantially flexible. Such an embodiment allows the power network line not to be torn by twisting of the wind turbine installation in one direction or the other. Such flexible power network lines are known to the skilled person.

A power network line that can twist inside a tower console is shown, for example, in US2012/051939 A1. A slip ring is a well-known component in electromechanics for providing a sliding contact for current and signal transmission between a fixed and a rotatably mounted element.

- 5 In a particularly preferred embodiment, the slip ring is located at the foundation of the wind turbine installation.

In a particular embodiment, the wind turbine installation according to the invention is designed to be locked from the outside. In a particular embodiment, the wind turbine installation may comprise a door or hatch for entry into the wind turbine installation. This door or hatch may be
10 configured such that it can be opened from the outside only by means of a key or other security device, such as a code entry or a batch. In a particular embodiment, the wind turbine installation according to the invention may further comprise a window, which may be fully or partially glazed and may allow either sunlight to enter the interior of the wind turbine installation or to look out from the wind turbine installation at components of the turbine support with the wind turbines
15 that are otherwise difficult to see.

A wind turbine installation system that is locked from the outside prevents unauthorized entry or tampering with the wind turbine installation by third parties. Such a wind turbine installation would be better protected from acts of vandalism. Furthermore, the risk of third parties being harmed by mechanical components or movements of the wind turbine installation would be
20 minimized.

In another particular embodiment, the wind turbine installation comprises a climbing facility up to the turbine support. By means of this climbing facility, the entire wind turbine can be reached, for example, in case of maintenance or during assembly or disassembly of the wind turbines. The climbing facility can be provided by a ladder, stairs or an elevator system, according to the
25 particular needs of the skilled person.

In another particular embodiment, the wind turbine installation according to the invention comprises a maintenance hatch with a cover. Through such a maintenance hatch, the interior of the wind turbine installation can be accessed or, conversely, the wind turbine installation can be exited at locations that are otherwise difficult to reach from the outside. Analogous to the door or
30 hatch above, this maintenance hatch with a cover can also be provided with a locking device or a key system.

In a further embodiment of the wind turbine installation according to the invention, this comprises at least one fastening of the tower console to a foundation. In this particular embodiment, the fastening in the assembled wind turbine is in the interior and thus inaccessible from the outside. To reach the fastening of the tower console, the interior of the wind turbine installation must be entered by means of a door or hatch.

Another aspect of the present invention relates to a wind turbine installation having a tower console, wherein the turbine support having at least two wind turbines is rotatable on at least one tower pillar having electronics to a power network line and a foundation having a bearing location. In a particular embodiment, the wind turbine with a generator cable and the electronics can rotate about the vertical axis around a bearing location. In another particular embodiment, a wind yaw tracker with a control line and electronics via an electrical line and a yaw drive is rotatable about the vertical axis with a bearing location.

In another particular embodiment, an inner housing is provided which is rotatable with the tower pillars and turbine support with a bearing location to the tower console. In a particular embodiment, a power connection between the electronics and the power network line is a slip ring. In another particular embodiment, the electronics are connected to a flexible power network line. In a further particular embodiment, a door for entry and a window is/are provided. In yet another particular embodiment, a climbing facility is provided up to the turbine support. In a further particular embodiment, a climbing facility to the tower console is provided via a cover. In yet another particular embodiment, the fastening of the tower console is interior.

Further advantageous embodiments and combinations of features of the invention result from the following detailed description and the totality of the patent claims.

Brief description of the drawings

Further advantageous embodiments and combinations of features of the invention result from the following detailed description and the entirety of the patent claims, without, however, being limited to these.

The figures show:

Figur 1 schematically shows a wind turbine installation according to the invention with a turbine console mounted on top;

Figur 2 schematically shows a wind turbine installation according to the invention, in which the turbine console is mounted on the foundation.

Basically, the same parts are provided with the same reference signs in the figures.

Ways to carry out the invention

5 Figure 1 shows a wind turbine installation according to the invention. The wind turbine installation has a foundation 15 which was prefabricated from shotcrete and on which the tower console 1 is placed by means of fastening elements 10. The fastening elements 10 can be, for example, bolts, locking screws or also rivets made of steel, which fix the tower console to the foundation in corresponding holes of the foundation 15 by means of a flange (not specifically
10 shown).

In a trough of the foundation 15, the power network line 13 is located, which can directly feed the power generated by the wind turbine installation into a network. The wind turbine installation, which is shown here as an example, can feed power directly into the power grid without having to process the power elsewhere. For this purpose, it comprises electronics 18 in the interior, which
15 comprise all the essential components for transferring the electrical power into the power network line 13 in a network-compatible manner. The power network line 13 comprises a substantially flexible material that can withstand twisting without any loss of power. The electronics 18 are further connected by generator cables 3, 3', 3" to the generators (not shown) of the individual wind turbines 4, 4', 4". In the present embodiment, the wind turbine installation comprises a total of
20 three wind turbines 4, 4', 4" arranged on a horizontal turbine support 17. The turbine support 17 is on a plane horizontal to the foundation 15 and the ground respectively. Also mounted on the turbine support 17 is a wind yaw tracker 11. This can be designed, for example, as an anemometer. This allows characteristics of the wind, such as wind direction and wind speed, to be measured and transmitted to the electronics 18 via a control line 8.

25 The electronics 18 may have a processor that calculates an optimal orientation of the wind turbine installation based on the measured wind parameters, which are forwarded from the wind yaw tracker 11 to the electronics via the control line 8. The electronics 18 controls a yaw drive 12 for this purpose. The yaw drive 12 can control the overall alignment of the part of the wind turbine installation to which the turbine support is fastened by means of a gear, for example a toothed
30 gear, which runs radially to the circumference of the tower console. This also rotates the electronics 18. The turbine support 17 with the turbines 4, 4', 4" thus rotates about the vertical axis of a perpendicular to the horizontal extent of the turbine support 17. The turbine support 17 is connected to the body of the wind turbine installation by two tower pillars 5, 5'. The turbine

support 17 and the tower pillars 5, 5' are provided with conduit cavities in the interior through which the generator cables 3, 3', 3" and the control line 8 can be connected to the electronics 18, respectively.

5 The tower console 1 has a bearing point to the elements of the electronics, tower pillar 5, 5' and turbine support 17, allowing the latter to rotate while the tower console itself remains stationary with respect to the foundation 15. Since the electronics 18 rotate, the power network line 13 must be designed to be flexible.

10 In this embodiment, the wind turbine installation is provided with a door 9 through which, for example, maintenance personnel can enter the interior of the wind turbine installation and gain access to the electronics 18. A window 19 on the top of the turbine plant body allows a view of the wind turbines 4, 4', 4".

Figure 2 shows an alternative embodiment of the wind turbine installation according to the invention. This wind turbine installation also comprises a total of three wind turbines 4, 4', 4", which are arranged on a horizontal turbine support 17. The wind turbines 4, 4' and 4" are equipped with generators which produce electrical power from the wind energy (not shown). In order to derive the electrical power from the wind turbines 4, 4', 4", generator cables 3, 3', 3" are provided, one generator cable 3, 3', 3" being provided for each wind turbine 4, 4', 4". These generator cables 3, 3', 3" conduct the current to a central electronics 18. In this embodiment, a yaw drive 12 is also provided, which is supplied with electrical power by the electronics 18 by means of an electrical line 6. In contrast to Figure 1, in this embodiment the yaw drive is close to the foundation.

20 The wind turbine installation shown here further comprises a turbine console 1, which comprises bearing points 2 at the foundation 15. These bearing points allow rotation of the tower console 1 and, associated therewith, of the entire arrangement of wind turbines 4, 4', 4" about the vertical axis of the turbine console 1 with respect to the foundation 15. In order to nevertheless permit transfer of the electrical energy generated, a slip ring 14 is provided which, in the present embodiment, is located in a trough of the foundation 15 and maintains there a slip connection to the power network line 13.

25 This embodiment also provides a door 9 through which the interior of the tower console 1 can be accessed, providing access to the electronics 18 for a maintenance technician. The wind turbine installation shown also includes a climbing facility 7 through which a maintenance hatch 20 with cover on the roof of the turbine console 1 can be accessed. This also allows a maintenance person to reach the turbine support 17 and the wind turbines 4, 4', 4". To make this even easier to reach, steps can be provided along the tower pillars 5, 5'.

With the wind turbine installation shown, it is possible to provide altogether more compact, safer and no less efficient wind turbine installations.

P a t e n t k r a v

1. Vindturbineanlæg til strømgenerering, omfattende:

a) en turbinebærer (17) med mindst to vindturbiner (4, 4', 4'');

5 b) en tårnkonsol (1) med mindst et lejringssted (2), via hvilket der er muliggjort en drejebevægelse af turbinebæreren (17) omkring en vertikal akse af turbinebæreren (17) og i forhold til et fundament (15);

c) mindst en tårnstøtte (5, 5'), via hvilken turbinebæreren (17) er forbundet med tårnkonsollen (1);

10 d) en elektronik (18) omfattende en elektronisk styring, hvor elektronikken (18) er konstrueret til at overføre elektrisk strøm til en netledning (13) på en netkonform måde, hvor elektronikken (18) i vindturbineanlæggets tårnkonsol (1) er indrettet på en sådan måde, at den i forhold til fundamentet (15) og en netledning (13) er drejelig omkring den vertikale akse af turbinebæreren (17), og

15 hvor vindturbineanlægget har en dør (9) til indstigningen i vindturbineanlægget, hvor vedligeholdelsespersonale gennem døren (9) kan betræde det indre af tårnkonsollen (1) og får adgang til elektronikken (18).

20 **2.** Vindturbineanlæg ifølge krav 1, hvor turbinebæreren (17) er orienteret i det væsentlige horisontalt i forhold til fundamentet (15) eller jorden.

3. Vindturbineanlæg ifølge et af kravene 1 eller 2, hvor tårnkonsollen (1) er udformet på en sådan måde, at den er drejelig sammen med turbinebæreren

25 (17).

4. Vindturbineanlæg ifølge et af kravene 1 eller 2, hvor tårnkonsollen (1) er udformet på en sådan måde, at den ikke er drejelig i forhold til fundamentet

30 (15).

5. Vindturbineanlæg ifølge et af kravene 1 til 4, yderligere omfattende mindst et generatorkabel (3, 3', 3'') pr. vindturbine (4, 4', 4''), som er udformet på en sådan måde, at det er drejeligt sammen turbinebæreren (17).

5 **6.** Vindturbineanlæg ifølge et af kravene 1 til 5, hvor elektronikken yderligere omfatter
et yawdrev (12), en vindefterføring yaw (11), en styreledning (8) og en strømledning (6).

10 **7.** Vindturbineanlæg ifølge et af kravene 1 til 6, yderligere omfattende en slæbering (14) mellem elektronikken (18) og netledningen (13) til overførsel af elektriske signaler.

15 **8.** Vindturbineanlæg ifølge et af kravene 1 til 6, hvor netledningen (13) er udformet i det væsentlige fleksibelt.

9. Vindturbineanlæg ifølge et af kravene 1 til 8, omfattende døren (9) til indstigningen i vindturbineanlægget og et vindue (19).

20 **10.** Vindturbineanlæg ifølge et af kravene 1 til 9, yderligere omfattende en opstigning op til turbinebæreren (17).

25 **11.** Vindturbineanlæg ifølge et af kravene 1 til 10, yderligere omfattende en vedligeholdelsesluge med et dæksel (20).

30 **12.** Vindturbineanlæg ifølge krav 4, eller et af kravene 5-11 i kombination med krav 4, yderligere omfattende mindst en fastgørelse (10) af tårnkonsollen (1) på et fundament, og hvor fastgørelsen (10) i det monterede vindkraftanlæg er i det indre af vindkraftanlægget og utilgængelig udefra.

FIG.1

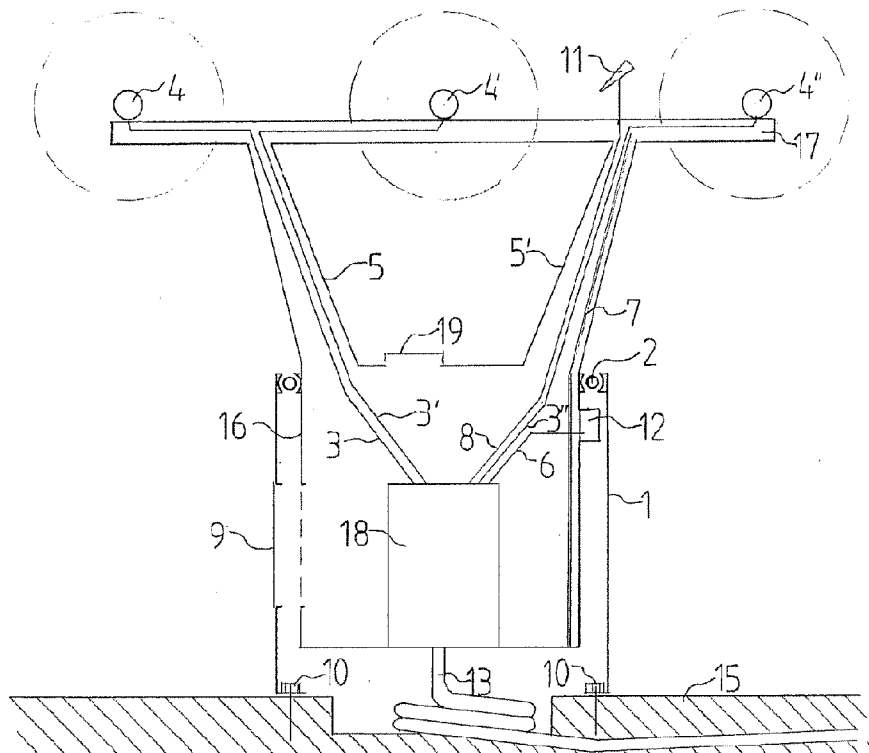


FIG.2

